MASKING IN THE SPIDER CRAB *TRICHOPLATUS HUTTONI* (BRACHYURA: MAJIDAE)

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ABSTRACT

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Masking behaviour of the endemic spider crab *Trichoplatus huttoni* was examined and found to be similar to that of other masking crab species, although *T. huttoni* is one of the few species that attach materials to their chelipeds. Crabs masked sparsely with a wide range of algae (average number of pieces applied ± SE = 20.11 ± 2.21). Number of algal pieces applied did not vary with size of the crab, although lengths of algal pieces increased with increasing size of the crab, and algal pieces applied to the carapace were longer than those applied to the chelipeds and legs. Distribution of hooked setae to which algae is attached was the same in all crabs, with the exception of mature male crabs which exhibited a reduction in the number of hooked setae on their chelae.

KEYWORDS: crab - masking - algae - camouflage -*Trichoplatus huttoni.*

INTRODUCTION

Many species of spider crabs (Brachyura: Majidae) exhibit masking behaviour, in which they attach materials from their environment to various parts of their bodies by means of hooked setae which hold the masking material in place (Getty & Hazlett 1978, Wicksten 1980, Mastro 1981, Pack 1982, Kilar & Lou 1986, Woods & McLay 1994). Materials used for masking include algae, hydroids, sponges, anemones and tubes of polychaete worms (Wicksten, 1980).

Trichoplatus huttoni A. Milne Edwards, 1876, is a spider crab endemic to New Zealand, distributed mainly around the southern regions of New Zealand, with a bathymetric range extending from the intertidal down to 60 m (McLay 1988). In its natural habitat it is found clinging to algae, masked with red, green and brown algae. *T. huttoni* is easily recognised because of its sub-chelate pereopods which are used to grasp the algae on which the crab lives. Other information available on *T. huttoni* remains poor due to its infrequent capture and cryptic nature. In this investigation, the masking behaviour of *T. huttoni* from Kaikoura was examined.

MATERIALS AND METHODS

From September 1994 - February 1995, crabs were collected from the Kaikoura Peninsula, South Island, New Zealand, by searching through algae intertidally and subtidally by snorkeling. The algal mask of each crab captured was removed and number of algal pieces applied to each body part counted and lengths of individual pieces measured.

Distribution of the hooked setae to which the algae was attached was examined under a stereo microscope and mapped for each crab (it appeared from initial observations that chelae of male and female crabs differed in the number of hooked setae they possessed).

The crabs were then placed in an aerated glass aquarium 35 cm X 18 cm X 18 cm, filled with small stones, rocks and algae representative of the areas from where the crabs were collected. Under dark-

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ened conditions, with a 15 W red light bulb providing illumination, the behaviour of the crabs was observed and recorded as they remasked.

STATISTICAL ANALYSIS

All analysis was performed using Systat 5.0. Single factor (one-way) analysis of variance (ANOVA) with post-hoc Tukey-Kramer HSD tests were performed to determine whether there were any differences in the number or length of algal pieces applied to different body parts of live crabs captured from Kaikoura. Also, number and mean length of algal pieces from the mask of the captured crabs were correlated with size of the crab (maximum carapace width) using Pearson Correlation Coefficients (Bonferroni adjusted probabilities).

A comparison of the number of hooked setae on the chelae among crabs of each sex was made using Students t-test. Also, the number of hooked setae on the chelae in relation to crab sex and size were examined using Pearson Correlation coefficients (Bonferroni adjusted probabilities).

RESULTS

A total of nine live *T. huttoni* were obtained. Crabs were found masked with a wide range of red, green and brown algae. These included *Champia novae-zelandiae*, *Corallina officinalis*, *Dasyclonium incisum*, *Echinothamnion lyallii*, *Halopteris* spp., *Laurencia thyrsifera*, *Plocamium angustum*, *Pterocladia lucida*, *Cladhymenia oblongifolia*, *Curdiea flabellata*, *Porphyra* sp., and *Ulva lactuca*.

Mean number ± SE of algal pieces applied per crab was 20.11 ± 2.21, and mean length of algal pieces applied per crab was 10.96 ± 2.50 mm (see Table 1 for mean numbers and lengths of algal pieces applied to different body parts). Number of algal pieces applied to individual body parts did not significantly differ (ANOVA, $F_{[4,44]} = 3.186$, $P>0.05$). Length of algal pieces applied to individual body parts did significantly differ (ANOVA, $F_{[4,181]} = 39.565$, $P<0.001$), with the carapace having longer pieces of algae (Tukey-Kramer HSD, $P<0.001$) than the chelipeds and legs.

Number of algal pieces applied was not significantly correlated with crab size ($r^2 = 0.453$, BPROB $P>0.05$) (Fig. 1). Mean length of algal pieces applied was significantly positively correlated with crab size ($r^2 = 0.771$, BPROB $P<0.05$) (Fig. 2).

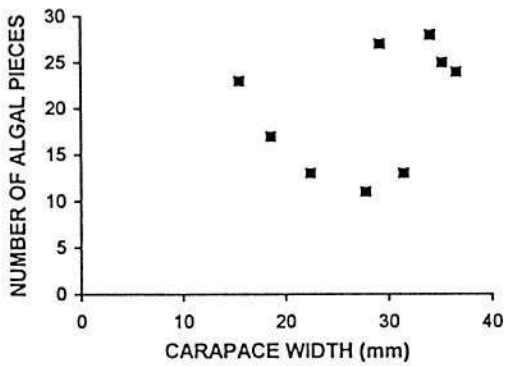

Figure 1. Number of algal pieces applied by *T. huttoni* in relation to crab size.

HOOKED SETAE DISTRIBUTION

Together with the nine live specimens collected, five specimens from the reference collection of the Edward Percival Field Station at Kaikoura, seven specimens from the Natural History Unit of the Museum of New Zealand, Te Papa Tongarewa, and one beach-cast specimen from Cape Campbell, South Island were also examined. Hooked setae were found only on dorsal surfaces of the crab's body and their distribution was as follows:

Carapace: Rostral horns with 2 clumps (2-3 setae each) of hooked setae (Fig. 3). Orbital and hepatic regions with one clump (2-3 setae) of hooked setae

Table 1. Mean number and length of algal pieces applied to each body part by *T. huttoni* (± SE).

	Mean Number	Mean Length (mm)
Left legs	4.88 ± 0.68	8.04 ± 1.06
Left cheliped	3.11 ± 0.48	9.85 ± 1.27
Carapace	4.00 ± 0.33	19.87 ± 2.70
Right cheliped	3.11 ± 0.42	10.65 ± 0.94
Right legs	5.11 ± 0.65	9.31 ± 1.09

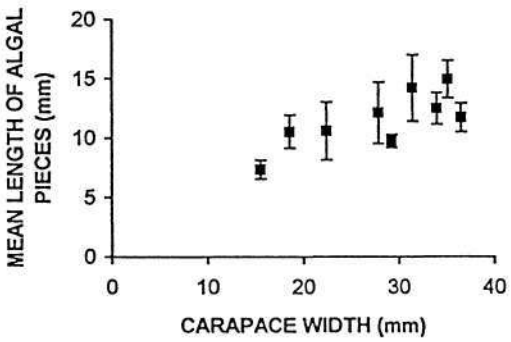

Figure 2. Mean length (± SE) of algal pieces applied by *T. huttoni* in relation to crab size.

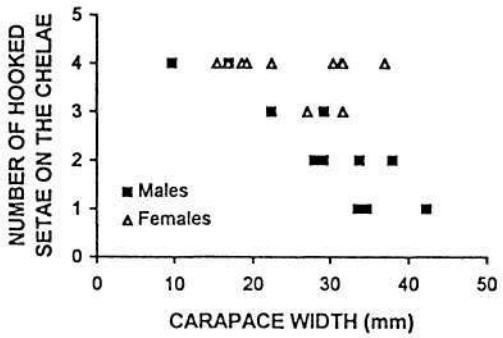

Figure 4. Number of hooked setae on the chelae of male and female *T. huttoni* in relation to crab size.

each. Branchial region with 3-4 single hooked setae. Chelipeds: Merus lined with 5 single hooked setae, carpus with 4 single hooked setae, and propodus with 1-4 single hooked setae.

Walking legs: Merus of first walking leg with 6 clumps (2-3 setae each) of hooked setae, carpus with 5 clumps (2 setae each) of hooked setae, and propodus with 3 single hooked setae. Merus and carpus of second walking legs with 5 single hooked setae, propodus with 2 single hooked setae. Merus of third walking leg with 4 single hooked setae, carpus with 5 single hooked setae and propodus with 1 single hooked setae. Fourth walking leg devoid of hooked setae.

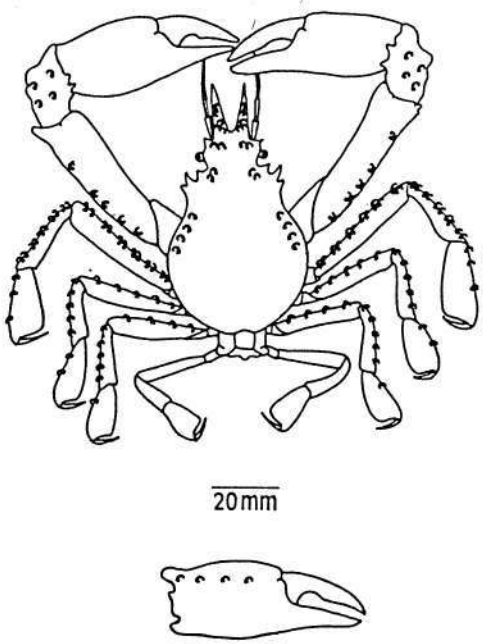

Figure 3. Dorsal view showing the distribution of hooked setae on *T. huttoni*

Given that clumps of hooked setae usually held only one piece of algae as did singular setae, this results in a total of 109 possible attachment sites. Distribution and number of hooked setae was similar for all crabs except for the hooked setae on the propodus of the chela of mature male crabs. Male crabs had significantly fewer hooked setae on the propodus (t=4.224, P<0.01) than female crabs. The number of hooked setae on the propodus in male crabs was significantly negatively correlated with crab size (r^2 = -0.884, BPROB P<0.001), while there was no significant correlation between number of hooked setae on the propodus and crab size in female crabs (r^2 = -0.253, BPROB P>0.05) (Fig. 4).

Masking

Masking began with the acquisition of algae which could be attached, or unattached to the substratum (i.e. drift algae). The chelipeds were used to grasp and pull the algae towards the third maxillipeds which clamped around it. The chelipeds then progressively cut, or wrenched off a piece of algae. Upon transfer to the mouthparts using the chelipeds, the third maxillipeds held the piece of algae while the second maxillipeds appeared to process the edges in some way. For branched algae, such as *Halopteris congesta*, only the cut end was processed by the mouthparts. For non-branched algae, such as *Ulva lactuca*, the entire piece of algae was rotated by the mouthparts and all the edges processed. During

processing by the mouthparts, the piece of algae was sometimes rejected and discarded.

The piece of algae was then transferred to the site of attachment using a single cheliped and rubbed against the hooked setae. As a result of this rubbing action, the piece of algae was either inserted between, and held by the hooked setae, or impaled upon them. If the piece of algae did not attach at first, it was transferred back to the mouthparts for further processing. Attachment was then attempted once again. Failing attachment at one site, attachment was sometimes attempted at different sites. Repeated attempts at attachment which failed saw the piece of algae discarded and a new piece selected.

Each cheliped was used to mask its own half of the carapace, and the cheliped and legs on the opposite side. When masking the carapace, the cheliped articulated back on itself over the carapace to attach the algae. To mask the cheliped and legs of the opposite side, the cheliped passed in front of the mouthparts and the limb to be masked was brought forward to aid masking. No definitive step-by-step masking order was observed, although the following appeared to be the usual order of masking: rostral, orbital and hepatic regions of the carapace, then chelipeds and legs, and finally the branchial region of the carapace.

DISCUSSION

The masking behaviour of *Trichoplatus huttoni*, obtained from Kaikoura, is similar to that recorded for other masking crabs, such as *Loxorhynchus crispatus* (Wicksten 1979) and *Notomithrax ursus* (McLay 1988, Woods & McLay 1994). The function of the mask is most commonly regarded as a visual or chemical camouflage from predators (Getty & Hazlett 1978, Wicksten 1978, 1979, 1980, 1983, Kilar & Lou 1984, Wilson 1987), although other functions - not necessarily mutually exclusive - are possible, e.g. predatory disguise (Flattely & Walton 1922, Wicksten 1980, 1983), facilitation of intraspecific displays (Hazlett & Estabrook 1974), and as a source of food (Calman 1911, Milligan 1915, Wicksten 1980, Mastro 1981, Kilar & Lou 1986, Woods & McLay 1994).

In its natural habitat, *T. huttoni* was found amongst clumps of algae, rostrum facing outwards, using its subchelate legs to maintain a firm grip on the algae (pers. obs). If the function of the mask is to visually or chemically disguise the crab from predators, then masking parts of the crab most likely to be exposed as the crab sits amongst algae, such as the front of the carapace, chelipeds and legs, would seem appropriate. Having the longest pieces of algae attached to the carapace, which was seen to be the most exposed part of the crab in the field, also supports the idea that the mask functions as camouflage, breaking up the outline of the crab.

Unlike other masking crabs, such as *N. ursus*, which mask heavily and utilise their mask as a food source in addition to camouflage (Woods & McLay 1994), it does not appear that the mask of *T. huttoni* functions as a food store - no instances of mask ingestion were recorded during the observation of live specimens.

Given its low density, utilising the mask as a food store might not be advantageous to *T. huttoni* because removal of pieces would decrease its effectiveness as camouflage. Also, if *T. huttoni* like many other spider crabs includes algae in its diet (Hartnoll 1963, Kilar & Lou 1986, Coen 1988, Woods 1993), then there might be little advantage in utilizing its mask as a food store because it has food readily at hand. This is in contrast to mask ingestors such as *N. ursus* which include algae in their diet and are often found under rocks, away from algae (Pack 1982). It would be of advantage to *T. huttoni*, however, to utilize its mask as a food store if it was found to mask with algae that it also preferred to eat - *T. huttoni* could then eat preferred algae from its mask while inhabiting algae not preferred as food, replacing the eaten algae from the mask with new pieces when it encounters the preferred algae again.

Trichoplatus huttoni is unusual amongst New Zealand masking crabs because it masks its chelipeds. The presence of hooked setae on chelipeds is very unusual for majid crabs. When immobile, masking crabs usually keep their chelipeds folded, partially hidden beneath their bodies (Wicksten 1980). *T. huttoni*, in contrast, was frequently observed in the laboratory amongst clumps of algae with its chelipeds partially extended in front of itself. Masking the chelipeds could facilitate predation by concealing the attacking appendages from potential prey. The diet of *T. huttoni* is not known, although I have observed them in the aquarium to eat amphipods and isopods moving amongst algae close to the crabs. Masking the chelipeds could allow *T. huttoni* to avoid predation itself, while still having the

advantage of having its chelipeds extended, ready to capture its prey.

Among different sized specimens of *T. huttoni*, the number and distribution of hooked setae remains relatively constant, with the exception of the hooked setae on the chelae of mature male crabs. The gradual reduction in the number of hooked setae on the chelae of larger male crabs results in fewer attachment sites for pieces of algae. The potentially less camouflaged chelipeds of large male crabs could facilitate visual intraspecific displays. Mature male *T. huttoni* have relatively larger chelipeds compared to females of the same size, suggesting a role in intraspecific displays, as observed among other species of crabs where intersexual differences in chela morphology occurs (Warner 1977).

Of the possible 109 sites for attachment, only an average of 20.1 ± 2.2 were actually used by the crabs. This density is not really adequate to completely cover the body. By comparison, *N. ursus* attaches about 100 pieces of algae. Considering the low density of the mask, the question could be asked "Why does *T. huttoni* mask at all - what advantage is to be gained from expending energy and time in masking only sparsely?" As *T. huttoni* was only found ensconced in clumps of algae, not on rocks or other exposed surfaces, the need for a heavy mask may be negated due to concealment from the clump of algae itself. Yet an algal mask, albeit a sparse one, could still be of advantage in camouflaging the crab, particularly when the crab is moving amongst clumps of algae or when water motion might expose the crab amongst the algae.

When collecting live specimens from Kaikoura, it was noted that there was some degree of correlation between colouration of crabs and the colour of the algae from which the crabs were collected. For example, three found in the red alga *Laurencia thyrsifera* were a deep red/purple in colour, while two others found amongst the brown alga *Marginariella boryana* were a brown/red in colour. This raises the possibility that *T. huttoni* may be able to take up algal pigments if it feeds on algae, and incorporate these into its exoskeleton as a means of camouflage in addition to its algal mask. Wilson (1987) found that *Acanthonyx petiveri* was able to take up algal pigments from algae it ingested and that it preferred to inhabit algae the same colour as its exoskeleton. This possibility would benefit from further investigation due to the small sample size of live crabs obtained in this study.

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